US Patent 5,995,172 issued November 30, 1999, to Ikeda et al. discloses a tablet integrated LCD display apparatus wherein a touch sensitive layer is formed on the same side of a substrate as the LCD.

US Patent 5,852,487 issued December 22, 1998, to Fujimori et al. discloses a liquid crystal display having a resistive touch screen. The display includes three substrates.

US Patent 6,177,918 issued January 23, 2001, to Colgan et al. describes a display device having a capacitive touch screen and LCD integrated on the same side of a substrate.

There remains a need for an improved touch screen-flat panel display system that minimizes device weight, removes redundant materials, decreases cost, eliminates special mechanical mounting design, increases reliability, prevents Newton rings, and minimizes the degradation in image quality.

SUMMARY OF THE INVENTION

The need is met according to the present invention by providing a touch screen display that includes an electroluminescent display; a touch screen, and a transparent sheet that functions as an element of both the electroluminescent display and the touch screen

ADVANTAGES

The display according to the present invention is advantageous in that it provides a display having a minimum number of substrates, thereby providing a thin, light, easily manufacturable display.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic diagram showing the basic structure of a prior art touch screen;

Fig. 2a and 2b are schematic diagrams showing the structure of a prior art resistive touch screen;

Fig. 3a and 3b are schematic diagrams showing the structure of a prior art capacitive touch screen;

Fig. 4a and 4b are schematic diagrams showing the structure of a prior art surface acoustic wave touch screen;

Fig. 5 is a schematic diagram showing the structure of a prior art bottom-emitting organic electroluminescent display;

Fig. 6 is a schematic diagram showing the structure of a prior art top-emitting organic electroluminescent display;

Fig. 7 is a schematic diagram showing the combination of a touch screen with a flat panel electroluminescent display as would be accomplished in the prior art;

Fig. 8 is a schematic diagram showing the basic structure of a bottom-emitting electroluminescent display with a touch screen according to the present invention;

Fig. 9 is a schematic diagram showing an embodiment of the present invention including a resistive touch screen utilizing a bottom-emitting structure;

Fig. 10 is a schematic diagram showing an embodiment of the present invention with a capacitive touch screen utilizing a bottom-emitting structure;

Fig. 11 is a schematic diagram showing an embodiment of the present invention with a surface acoustic wave touch screen utilizing a bottom-emitting structure;

Fig. 12 is a schematic diagram showing the basic structure of a top-emitting electroluminescent display with a touch screen according to the present invention;

Fig. 13 is a schematic diagram showing an embodiment of the present invention including a resistive touch screen utilizing a top-emitting structure;

Fig. 14 is a schematic diagram showing an embodiment of the present invention with a capacitive touch screen utilizing a top-emitting structure; and

Fig. 15 is a schematic diagram showing an embodiment of the present invention with a surface acoustic wave touch screen utilizing a top-emitting structure.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Fig. 8, a touch screen display generally designated **100** according to the present invention includes a transparent sheet **102** having light emitting elements **52** of an electroluminescent display formed on one face of the substrate for emitting light through the substrate, in a bottom-emitting structure, and touch sensitive elements **14** of a touch screen formed on the other face of the transparent sheet **102.** The transparent sheet **102** is made of a transparent material, such as glass or plastic, and is thick enough to provide mechanical support for both the light emitting elements **52** and the touch sensitive elements **14**. This improved display eliminates the need for a second substrate, and allows both the light emitting elements **52** of the image display and the touch sensitive elements **14** to be formed on the same substrate without interfering with each other. This reduces system cost, manufacturing cost, and system integration complexity. Various prior art touch screen technologies may be employed in the touch screen display **100** as described below.

Referring to Fig. 9, a touch screen display **100** including a resistive touch screen according to one embodiment of the present invention utilizing a bottom-emitting structure is shown. A lower circuit layer **20** and metal interconnections **54** are formed, for example by photolithographically patterning respective conductive layers on opposite faces of transparent sheet **102**. The conductive layers comprise for example a semitransparent metal, typically ITO. On the image display side of the transparent sheet **102**, a hole injection layer (HIL) **56** is applied to the device over the metal interconnections **54**. Then